

Conservation and management efforts of medicinal and aromatic plants in Nepal

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Out of 5856 flowering plants recorded in Nepal, 690 species are identified as medicinal plants. A vast majority of rural people in Nepal still practice traditional knowledge and depend on medicinal plants for primary health care. Collection and trade of Medicinal and Aromatic Plants (MAPs) has also been the source of their income. On the other hand, a huge quantity of Non Timber Forest Products (NTFPs) is exported from Nepal every year, majority of which are MAPs. In the fiscal year 2000/2001 approximately 3200 tons of NTFP species was exported from Nepal contributing to only NRs. 14.9 million as revenue.

Medicinal plants of commercial value are in a state of threat due to deforestation and over harvesting. For this reason conservation, management and sustainable utilization of medicinal plants is necessary for Nepal. Threat assesment, cultivation practices and regularize systems for conservation and management are major activities for sustainable utilization of MAP resources. His Majesty's Government of Nepal has recently adopted Herbs and NTFP Development policy to develop this sector.

Keyword: Medicinal plants, non timber forest products, conservation, revenue

Of the 5856 flowering plants recorded in Nepal (HMGN 2002), 690 species are considered having medicinal properties (Malla and Shakya 1984). This comprises about 12 percent of the total number of flowering plants of Nepal. This list includes 510 wild species, 120 cultivated and naturalized, and 60 exotic. The Medicinal and Aromatic Plant Database of Nepal (MAPDON) has listed 1624 medicinal and aromatic plants, which are commonly available in crude drug market, under cultivation and in wild form (Shrestha *et al.* 2000). A proper documentation of Nepalese medicinal plants is still lacking (Sharma *et al.* 2004).

It is estimated that only 15-20 percent of the population of Nepal living in and around the urban areas have access to the modern medicinal facilities, where as, the rest depend on traditional medicines.

The collection and trade of medicinal plants have remained one of the sources of rural livelihood. The data of Department of Forests (DOF 2002) shows that 3200 tons of NTFPs were exported from Nepal contributing NRs. 14.9 million as revenue in the fiscal year 2000/2001. However lack of proper management has rendered plants of high commercial value in a state of threat. This is prevalent throughout

the country. Fifty-one medicinal plants have entered into different threat categories such as rare, endangered, vulnerable, and commercially threatened (Bhattarai *et al.* 2002). For this reason, conservation and sustainable utilization of medicinal plants have been identified as the key issues for Nepal. His Majesty's Government of Nepal has, in the recent time given this matter a high priority and adopted Herbs and NTFPs Development policy to develop this sub-sector for the benefit of rural people in general.

Literature pertaining to on MAPs

Literature related to medicinal plants published in national and international journals have been recently compiled (Sharma *et al.* 2004). There are many grey literatures as well. Publications fall in several disciplines such as research, management, and general studies on medicinal plants of Nepal. Majority of them are on ethno-botany. Knowledge on folk medicines, folk remedies and ethnic uses of medicinal plants have been reported in a great deal. Non-Timber Forest Products (NTFPs) have become a popular buzzword; as a result, good-sized literature is currently available on NTFPs. Medicinal plants cover a major part of the NTFPs.

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* Data for Mid-Western Development region have been added based on personal communications.

Some old Nepali publications are remarkable. In this context two Nighantus need worth mentioning here. Pandit Ghana Nath Devkota prepared "Chandra Nighantu" during the reign of Prime Minister Chandra Shumshere Jung Bahadur Rana. It is a hand written document consisting 11 volumes, of which 8 volumes are botanical, 1 zoological, 1 minerals and the last volume serves as a subject of index. This Nighantu includes 840 colour plates (750 of plants and 90 of animals). It contains detailed process of preparation of Ayurvedic medicines (Devkota u.d.). The original hand written document of Chandra Nighantu is archived in Singhdurbar Vaidya Khana, an Ayurvedic pharmaceutical industry of the Ministry of Health (IUCN 2000). Later, Kosh Nath Devkota (son of Ghana Nath Devkota) published Nepali Nighantu from Royal Nepal Academy in 1968 (Devkota 1968).

Threatened and protected MAPs

In many parts of Nepal, MAPs in the wild are depleting due to continuous harvests without any plan to regenerate and sustain them. These plants occur even now in good density in national parks and reserves, where harvest is prohibited or restricted. Over-harvesting of resources in many cases has made them rare in the wild, in some cases threatening or even endangering their status. To minimize such threat, measures taken by the Government include putting ban on the collection of resources or

restricting their export in raw form (Table 1). Currently, 60 species of non-endemic plants of Nepal are considered as threatened (Shrestha and Joshi 1996), based on IUCN threat-categories. Among them, 29 species are medicinal and aromatic plants (Table 2).

The International Development Research Center (IDRC) funded Conservation Assessment and Management Planning (CAMP) workshop, held in Pokhara in 2000 attempted to assess the conservation and management status of MAPs of Nepal using IUCN guidelines (Bhattarai *et al.* 2002). Fifty-one MAP species have been assigned to various categories: 3 taxa are classified as 'Critically Endangered', 14 as 'Endangered', 23 as 'Vulnerable', 3 'Nearly Threatened', 1 taxon as of 'Least Concern', and 7 taxa as having 'Data Deficient' (Table 2). This list includes 6 endemic plants (*Aconitum balangrense*, *Allium oypsisistum*, *Corydalis megacalyx*, *Delphinium himalayai*, *Heracleum lallii*, and *Meconopsis dhwojii*). This analysis gives clear warning bells to act immediately to halt or reverse the current trend of degradation, so that a healthy resource bases of these plants could be maintained.

National policies on conservation and use of medicinal plants

The Master Plan for Forestry Sector (1989-2010) of His Majesty's Government of Nepal (HMGN) has

Table 1: Protected Plants of Nepal

S.N.	Scientific Name	Nepali Name
I. Banned for collection, transportation and trade		
1.	<i>Dactylorhiza hatagirea</i>	Paanchaunle
2.	Root bark of <i>Juglans regia</i>	Okhar ko bokraa
3.	<i>Picrorhiza scrophulariiflora</i>	Kutki*
II. Banned for export outside the country without processing (Not applicable for cultivated products)		
1.	<i>Nardostachys grandiflora</i>	Jataamansi
2.	<i>Rauvolfia serpentina</i>	Sarpagandhraa
3.	<i>Cinnamomum glaucescens</i>	Sugandhakokilaa
4.	<i>Valeriana jatamansi</i>	Sugandhawaal
5.	Lichen spp.	Jhyaau
6.	<i>Abies spectabilis</i>	Taalispatra
7.	<i>Taxus wallichiana</i>	Lauth sallaa
8.	<i>Cordyceps sinensis</i>	Yaarsaagomba
III. Banned for felling, transportation and export		
1.	<i>Michelia champaca</i>	Chaamp
2.	<i>Acacia catechu</i>	Khayar
3.	<i>Shorea robusta</i>	Saal
4.	<i>Bombax ceiba</i>	Simal
5.	<i>Dalbergia latifolia</i>	Satisaal
6.	<i>Pteocarpus marsupium</i>	Bijayasaal
7.	<i>Juglans regia</i>	Okhar

* Recently the ban has been lifted for products legally harvested from sustainably managed forests

Table 2. List of threatened medicinal and aromatic plants in Nepal

S. No.	Plant species	Nepali name	Threat category	
			CAMP	IUCN
1.	<i>Michelia champaca</i> L.	Chaamp	CR	EN
2.	<i>Pterocarpus marsupium</i> Roxb.	Bijaysaal	CR	-
3.	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	Sarpagandhaa	CR	EN
4.	<i>Aconitum balangrense</i> Lauener	Bikh	EN	----
5.	<i>Alstonia nerifolia</i> D. Don	----	EN	R
6.	<i>Corydalis megacalyx</i> Ludlow	----	EN	----
7.	<i>Crateva unilocularis</i> Buch. – Ham.	Siplikaan	EN	R
8.	<i>Dactyloctenium aegyptium</i> (L.) W. Greuter & Burdet	Paanchaunle	EN	----
9.	<i>Dioscorea deltoidea</i> Wall.	Bhyaakur	EN	T
10.	<i>Ephedra intermedia</i> Schrenk & C. A. Mey	Somlataa	EN	----
11.	<i>Gloriosa superba</i> L.	Kewari	EN	R
12.	<i>Heracleum lalii</i> C. Nornan	----	EN	----
13.	<i>Operculina turpethum</i> (L.) S. Manso	Nisoth	EN	----
14.	<i>Oroxylum indicum</i> (L.) Kurz	Tatelo	EN	V
15.	<i>Otocbilus porrectus</i> Lindl.	----	EN	----
16.	<i>Pistacia chinensis</i> subsp. <i>nitegemima</i> (J.L. Stewart) Rech.	Kaakarsingi	----	R
17.	<i>Swertia angustifolia</i> Buch. – Ham ex D. Don	Bhaale chiraito	EN	----
18.	<i>Taxus wallichiana</i> Zucc.	Lauth salla	EN	----
19.	<i>Acacia catechu</i> (L. f.) Willd.	Khayar	----	T
20.	<i>Aconitum gammiei</i> Stapf	Bikh	----	R
21.	<i>Aconitum heterophyllum</i> Wall.	Atis	V	R
22.	<i>Aconitum laciniatum</i> (Bruhl) Stapf	Bikh	----	T
23.	<i>Aconitum spicatum</i> (Bruhl) Stapf	Bikh	V	T
24.	<i>Allium hypsistum</i> Stearnb.	Jimbu	V	----
25.	<i>Allium przewalskianum</i> Regel	Jimbu	----	V
26.	<i>Alstonia scholaris</i> (L.) R. Br.	Chhatiwan	V	R
27.	<i>Arnebia benthami</i> (Wall. ex G. Don) John	Mahaarangi	V	----
28.	<i>Asparagus racemosus</i> Willd.	Sataawari	V	----
29.	<i>Bergenia ciliata</i> (Haw.) Stearnb.	Paakhanbed	----	T
30.	<i>Butea monosperma</i> (Lam.) Kuntze	Palas	V	EN
31.	<i>Curculigo orchioides</i> Gaertn	Kalo musali	V	----
32.	<i>Dalbergia latifolia</i> Roxb.	Satisaal	----	V
33.	<i>Delphinium himalayai</i> Munz	Atis	V	----
34.	<i>Elaeocarpus sphaericus</i> (Gaertn.) Sch.	Rudraakshya	----	V
35.	<i>Ephemerantha macraei</i> (Lindl.) Hunt. Sum.	Jiwanti	V	----
36.	<i>Fritillaria cirrhosa</i> D. Don	Kaakoli	V	----
37.	<i>Nardostachys grandiflora</i> DC.	Jataamansi	V	V
38.	<i>Neopicrorhiza scrophulariifolia</i> (Pennell) Hong	Kutaki	V	V
39.	<i>Paeonia emodi</i> Wall.	Chandra	----	R
40.	<i>Panax pseudo-ginseng</i> Wall.	Mangan	V	----
41.	<i>Paris polyphylla</i> Sm.	Satuwaa	V	V
42.	<i>Piper longum</i> Linn.	Pipalaa	V	----
43.	<i>Podophyllum hexandrum</i> Royle	Laghupatra	V	V
44.	<i>Rheum australe</i> D. Don	Padamchaal	V	----
45.	<i>Rheum nobile</i> Hook. f. Thoms.	Amalbetas	V	R
46.	<i>Rubia manjith</i> Roxb.	Majitho	V	----
47.	<i>Swertia chirayita</i> (Roxb. ex Flem.) Karstn.	Chiraito	V	V
48.	<i>Tinospora sinensis</i> (Lour.) Merr.	Gurjo	V	----
49.	<i>Valeriana jatamansi</i> Jones	Sugandhawaal	V	----
50.	<i>Jurinea dolomiaea</i> Boiss	Dhupjadi	NT	----
51.	<i>Meconopsis dhwojii</i> G. Taylor ex Hay	----	NT	----
52.	<i>Rheum moorcroftianum</i> Royle	Padamchaal	NT	----
53.	<i>Arisaema costatum</i> (Wall.) Mart. ex Schott	Sarpako makai	LC	----
54.	<i>Aconitum bisma</i> (Buch. – Ham.) ex Rap.	Bikh	DD	----
55.	<i>Aconitum ferox</i> Wall. Seringe	Seto bikh	DD	T
56.	<i>Lilium nepalense</i> D. Don	Khiraule	DD	----
57.	<i>Maharanga bicolor</i> (Wall. ex G. Don) A. DC.	Mahaarangi	DD	K
58.	<i>Maharanga emodi</i> (Wall.) A. DC.	Mahaarangi	DD	K
59.	<i>Pongamia pinnata</i> (L.) Pierre	Karengi	DD	----
60.	<i>Swertia multicaulis</i> D. Don	Sarmaaguru	DD	----

CR = Critically Endangered, DD = Data deficient, EN = Endangered, K = Insufficiently known, NT = Nearly threatened, And V = Vulnerable

Sources: Shrestha and Joshi (1996; Bhattarai et al. (2001)

recognized the role of MAPs to uplift the socio economic condition of the local people. The current Tenth Five Year Plan (2003-2008) has given emphasis to the development of MAPs as a priority programme alleviating poverty. Rare and high priced medicinal herbs are on top priority for domestication, research, and cultivation, processing and marketing. The Plan has also stipulated to adopt suitable laws that creates enabling environment for the development of this sub-sector.

Forest Act (1993) and Forest Regulations (1995) describe ways, by which forests will be managed, resources harvested and exported out of the forests. It also provides mechanism to conserve biodiversity and non-timber forest products. In order to conserve and manage wild NTFPs, including medicinal and aromatic plants in sustainable way, the HMGN has given various modes of protection; some plants are totally banned, while others can be harvested but must be processed before export (Table 1). Some trees are also protected and green felling is not permitted in government managed forests unless prescribed under Forest Management Plan (Table 1). The community forestry programme, one of the priority programmes, aims to produce a wide range of forest products for subsistence needs, which include many NTFPs, especially MAP species. The community forestry in Nepal has been emerging as one of the most successful forestry programs and it has already involved more than 1.48 million households covering more than 1.07 million ha. One estimate puts that 35 percent of the total population of the country is benefitting from the community forests (Kanel and Kandel 2004). The community forestry involves local farmers who are also the potential herb growers and since government policy is to promote NTFP propagation in community forests, there is a vast potential to produce MAPs on commercial scales in community forests.

Small pilot projects promoting cultivation of commercially potential MAPs in some community forests in Nepal, especially in Daman and in the Western part of the country, have shown Promising results.

Herbs and NTFP Coordination Committee

A national-level Herbs and NTFP Coordination Committee (HNTFPCC) has been formed under the chairmanship of Minister of Forests and Soil

Conservation in the year 2002. The 13-membered committee has its secretariat based in the Department of Plant Resources. The HNTFPCC aims to formulate appropriate policy for the overall development of NTFP sector. It also aims to create legislative and other enabling environment in which Herbs and NTFPs, in general, are conserved, sustainably harvested and benefits shared equally among the rural communities. The Secretariat also provides technical and other supports to the concerned traders and entrepreneurs, and provides a platform for coordination for government agencies and other stakeholders (See Box 1).

Box 1: Objectives of Herbs and NTFP Coordination committee

- To set long-term goal and formulate national policies related to Herbs and NTFPs.
- To formulate and implement acts, rules and directives for the sustainable development of Herbs and NTFP related policy.
- To develop strategies for program implementation in coordination with different agencies on priority basis as directed by the national policy.
- To coordinate, evaluate and monitor Herbs and NTFP related activities between government, non-government and private sector, and
- To establish and coordinate interrelationships of programmes regarding resource conservation, research, technology development, marketing, training and publicity related to Herbs and NTFPs.

The Government has recently approved policy on NTFP development. The implementation of this policy will help in conservation, management, utilization, marketing, trade and export promotion, simplification of taxation and certification, and various other activities that are essential to develop herbs and NTFPs as a new sector. It will also help resolve different constraints and issues present in herbs and NTFP development.

Current efforts on Conservation and use

In situ conservation

Nepal's 22 protected areas (PAs) spread in all major ecological zones, protect a good representative samples of plant resources also. Among these protected areas are nine national parks, three wildlife reserves, one hunting reserve, three conservation areas and six buffer zones, a total of almost 2.7

million ha areas, constituting over 18.3 percent of country's total land area (DNPWC 2003). Two more buffer zones have recently been added to the list. The Department of National Parks and Wildlife Conservation aspires to bring one quarter of the nation's land under protected area system (Sharma 2000). Nepal is also gradually trying to manage protected areas within their broader bioregional context. There has been an initiative by the Government in close collaboration with WWF Nepal to surround all national parks and reserves with protective buffer zones and to link adjoining PAs with biodiversity-friendly corridors.

These activities ongoing since 1975 have been greatly benefitting the concerns of the plants also. But there has been no deliberate effort to inventory the MAPs and manage PAs with particular focus on their conservation priorities. Many protected areas have prohibited the collection and utilization of MAP species with exception to occasional harvests for local and traditional uses.

Ex-situ conservation

Department of Plant Resources (DPR), formerly known as Department of Medicinal Plants (DMP), since its establishment in 1960, has been conducting research and development on medicinal plants of Nepal and germplasm conservation as its major activities. Currently DPR has seven district level offices from tropical to sub-alpine zones. The herbal farms in these offices and in the Royal Botanical Garden (Godawari) and Daman Botanical Garden (Daman) have been conserving important medicinal plants found in respective areas. However, these *ex-situ* conservation efforts are minimal compared to the vast resources available in the country. Besides, their methods of documentation are poor: the accession of conserved plants has not been maintained properly and methods of propagation have not been properly documented.

The CITES

Nepal is the signatory of Convention on International Trade in Endangered Species of Fauna and Flora (CITES). Some medicinal plants of Nepal are thus also regulated by CITES. DPR is the scientific authority for CITES, while Department of Forests is the management authority. Unlike fauna, the management authority of flora is not active in Nepal, and a clear policy and mechanism to export/import

CITES listed plants is lacking. Plant species included in CITES appendices are presented in Table 3. Of the 14 CITES listed species, *Dioscorea deltoidea*, *Podophyllum hexandrum*, *Rauvolfia serpentina*, *Taxus wallichiana* and some species under family Orchidaceae are important medicinal plants.

Table 3: Nepal's flora under CITES appendices

Plant name	Nepali name	Appendix
1. <i>Saussurea lappa</i> *	Kuth	I
2. <i>Ceropegia pubescens</i>	Mirke laharo	II
3. <i>Cyathea spinosa</i> (Tree fern)	Rukh unyu	II
4. <i>Cycas pectinata</i> (Cycas)	Jokar, Jaggar, Kalbal	II
5. <i>Dioscorea deltoidea</i>	Bhyaakur	II
6. Orchidaceae (Orchids)	Sunaakhari	II
7. <i>Podophyllum hexandrum</i>	Laghupatra	II
8. <i>Rauvolfia serpentina</i>	Sarpagandhaa	II
9. <i>Taxus wallichiana</i>	Lauth sallaa	II
10. <i>Gnetum montanum</i>	Bhote laharaa	III
11. <i>Meconopsis regia</i>	Kyashar	III
12. <i>Podocarpus neriifolius</i>	Gunsi	III
13. <i>Talauma bodgsonii</i>	Bhalu kaath	III
14. <i>Tetracentron sinense</i>	Jharikote	III

* An exotic species

Source: HMGN (2002)

Research and technology development

In Nepal several research institutions are conducting research on plants. These include Department of Plant Resources (DPR), Department of Forest Research and Survey (DFRS), Royal Nepal Academy of Science and Technology (RONAST), Research Centre for Applied Science and Technology (RECAST), the Central Department of Botany of Tribhuvan University and National Agriculture Research Council (NARC).

The National Herbarium and Plant Laboratory of DPR has explored the plant diversity in many parts of Nepal. This survey has resulted in the collection of almost 1,50,000 sheets of herbarium, ethno-botanical information and enumeration of 571 medicinal plants in Medicinal Plants of Nepal (DMP 1970) and its supplement volume (DPR 1984) published by the DPR. More plant explorations also took place later and their results have been published in subsequent publications of the Department. Although 690 MAP species have been reported, but the number is expected to be more.

A National Register of Medicinal Plants was published in 2000 by IUCN Nepal (IUCN 2000). In this register, 150 MAP species have been described. This publication has been revised and updated in 2004, which describes 187 MAP species (IUCN, 2004).

Natural Products Research Laboratory (NPRL) of the DPR performs phyto-chemical screening of medicinal and aromatic plants. There have been insufficient researches on phyto-chemical analysis and formulation of useful compounds. So far 219 plants have been studied and about 10 new plants are screened each year. These types of research can create new demand for resources in the industries and reduce the current trend of exporting herbs in raw forms.

Development of agro-technology

Research on agro-technology of important and commercially valued medicinal plants is an ongoing activity of the DPR. Over the past decades DPR has developed agro-technology of 11 medicinal and aromatic plants for the Nepalese climatic contexts. These are: *Atropa belladonna*, *Catharanthes roseus*, *Chrysanthemum cinerarifolium*, *Crocus sativus*, *Cymbopogon flexuosus*, *Cymbopogon martinii*, *Cymbopogon winterianus*, *Digitalis purpurea*, *Mentha piperata*, *Rauwolfia serpentina*, and *Valeriana jatamansi*. Among them, latter two are indigenous to Nepal. Nepal has good opportunities for trade of many indigenous medicinal and aromatic plants. A prioritized list of important and potential tradable indigenous medicinal and aromatic plants (Table 4) has been prepared by DPR for this purpose, based on specific criteria.

Some of these plants are also identified as threatened or vulnerable based on IUCN criteria (see Table 2). Domestication can prevent them from further

It is important that improved varieties of medicinal crops be used in cultivation for the maximum benefit. Some acceptable characters of wild species can also be used in crop improvement. A research on this

aspect can cross many milestones on the commercial cultivation of MAPs. A great deal is still to be done in Nepal in this aspect.

A set of mechanisms to maintain gene-bank of MAPs is the demand of the time. Although, Biotechnology section of National Herbarium and Plant Laboratory (Godawari) has maintained *in-vitro* conservation of some medicinal plants, it is only a negligible effort for such a vast genetic diversity of MAPs available in Nepal.

Amongst the list of 100 most traded plant species from Nepal (Amatya 2000), 21 MAP species have been found traded in high volume. The high demand of these species and gradual increase in their prices with growing rarity has resulted in the gradual depletion in the natural stock. Over-harvesting for commercial purpose is the main cause for their depletion and therefore need immediate conservation through sustainable management and utilization. The Herbs and NTFP Coordination Committee and DPR have compiled a list of MAPs that need special attention in terms of research and management (Table 5).

Inventory of MAPs

From time immemorial natural forests have remained the source of MAPs in Nepal to meet the demands of traditional drugs. Except for few species, there is no restriction in collection of these herbs. After paying fixed royalty to the HMGN any one can collect these herbs from the wild. Inventory of resources before issuing harvest permit is not yet in practice. A pilot project to assess five commercially important MAPs (*Cordyceps sinensis*, *Dactylorhiza hatagirea*, *Nardostachys grandiflora*, *Picrorhiza scrophulariiflora*, and

Table 4: List of MAPs prioritized for agro-technology

S. No.	Species	Family	Climatic zones
1.	<i>Asparagus racemosus</i>	Saatawari	Tr – S. Tr
2.	<i>Cinnamomum glaucescens</i>	Sugandhakokilaa	Tr – S. Tr
3.	<i>Dactylorhiza hatagirea</i>	Paanchaunle	S. A. - A.
4.	<i>Nardostachys grandiflora</i>	Jataamansi	S. A.
5.	<i>Picrorhiza scrophulariiflora</i>	Kutaki	S. A. – A.
6.	<i>Piper longum</i>	Pipalaa	Tr – S. Tr
7.	<i>Rauwolfia serpentina</i>	Sarpagandha	Tr. – S. Tr.
8.	<i>Swertia chirayita</i>	Chiraito	Te.
9.	<i>Taxus wallichiana</i>	Lauth sallaa	Te.
10.	<i>Tinospora sinensis</i>	Gurjo	Tr. – S. Tr.
11.	<i>Valeriana jatamansi</i>	Sugandhakokila	S. Tr.
12.	<i>Zanthoxylum armatum</i>	Timur	Te.

Tr. = Tropical, S. Tr. = Sub-tropical, Te. = Temperate, S. A. = Sub-alpine and A. = Alpine

Table 5: List of medicinal plants prioritized for research and management

S. No.	Scientific name	Vernacular name
1.	<i>Aconitum heterophyllum</i>	Atis
2.	<i>Aconitum spicatum</i>	Bikh
3.	<i>Acorus calamus</i>	Bojho
4.	<i>Asparagus racemosus</i>	Sataawari
5.	<i>Azadirachta indica</i>	Neem
6.	<i>Bergenia ciliata</i>	Pakhaanved
7.	<i>Cinnamomum glaucescens</i>	Sugandhakokilaa
8.	<i>Cinnamomum tamala</i>	Tejpaat/Nepali daalchini
9.	<i>Cordyceps sinensis</i>	Yarsaagumbaa
10.	<i>Dactylorhiza hatagirea</i>	Paanchaunle
11.	<i>Dioscorea deltoidea</i>	Bhyaakur
12.	<i>Gaultheria fragrantissima</i>	Dhasingare
13.	<i>Juglans regia</i>	Okhar
14.	Lichens	Jhyaau
15.	<i>Morchella</i> spp.	Guchchi chyaau
16.	<i>Nardostachys grandiflora</i>	Jataamasi
17.	<i>Phyllanthus emblica</i>	Amalaa
18.	<i>Picrorhiza scrophulariiflora</i>	Kutaki
19.	<i>Piper longum</i>	Pipalaa
20.	<i>Podophyllum hexandrum</i>	Laghupatra
21.	<i>Rauvolfia serpentina</i>	Sarpagandhaa
22.	<i>Rheum australe/</i> <i>Rheum moorcroftianum</i>	Padamchaal
23.	<i>Rubia manjith</i>	Majitho
24.	<i>Sapindus mukorossi</i>	Rithaa
25.	<i>Swertia chirayita</i>	Chiraaaito
26.	<i>Tagetes minuta</i>	Jangali sayapatri
27.	<i>Taxus wallichiana</i>	Lauthsallaa
28.	<i>Tinospora sinensis</i>	Gurjo
29.	<i>Valeriana jatamansi</i>	Sugandhawaal
30.	<i>Zanthoxylum armatum</i>	Timur

Taxus wallichiana) in selected districts with an aim to perfect inventory methodologies is under appraisal by the Government and the donor. Herbs and NTFP Coordination Committee and Department of Forest Research and Survey have jointly prepared the project. If this project materializes, it will open the door to develop suitable methodologies to assess five important medicinal plants. Similar efforts should be made for other commercially important plants also.

If the exact annual harvestable quantity from a particular area is known which is though a difficult proposition, it can lead to good harvesting practices and could encourage managers to put meaningful restrictions against over harvesting. Some studies have been conducted to quantify the natural stocks of MAPs. The expertise on methodologies is still at its early stage. More systematic efforts on this would be required.

Agro-technology applied in community forestry

Efforts in the past has not given desired impacts on the communities in motivating them in cultivating and conserving NTFPs, especially the MAPs. Only recently, Community Forest User' Groups (CFUGs) in selected areas have been targeted to revise work plan and introduce suitable MAPs activities. They have been encouraged to cultivate MAPs in their community forests and conserve and sustainably use the NTFPs naturally growing in their forests.

Adoption of MAPs by farmers or CFUG members does not only depend upon the availability of domestication technologies, but equally on the chain of other activities involving proper harvesting, grading, storage and cooperative arrangements for bargaining for better prices in the market. In some cases wrong selection of species promoted for domestication from the point of view of markets and in-country processing provisions has dampened the spirit of growing NTFPs in private or community lands. A careful intervention in this matter is vital for the success of any agro-technology.

Conclusion

The MAPs in Nepal is a vastly un-explored, under-utilized sub-sector in forestry. At the policy level, the role of NTFPs (especially MAPs) has been adequately emphasized, especially its role in alleviating poverty, the national goal. The implementation aspect is, however, poor. As the development of MAPs requires the support of various line agencies, their cases are not heard anywhere properly. The situation has not been suitable for investors to undertake large-scale cultivation of MAPs. The industries are only relying on the supply from the natural forests. This has resulted in the over-harvesting of resources and has not changed the age-old practice of exporting herbs in the raw form. Over-harvesting results in the rarity of species prompting government put some kind of ban on the species. The ban hardly lessens the harvests, but only pushes the black market activities, reducing the net income of the primary collectors and reducing national incomes. The recently introduced Herbs and NTFP Development Policy has a great deal to offer to ameliorate the situation and promote MAP cultivation and create more

favourable environment for the growth of this sub-sector.

The conservation of MAP germplasms in national parks, equivalent reserves and botanical gardens has been quite successful in Nepal. But, at the genetic level more effort would be necessary, especially in creating field gene banks and *in-vitro* gene banks. The farmers, especially those associated with the community forests can be encouraged in conservation and cultivation of commercially potential MAP species at a large scale. If the market-linkages are properly explored and certification mechanisms institutionalized keeping in view of the interest of growers/traders, commercial scale of MAPs can take off in Nepal.

For national forests, sustainable harvest of MAPs should be linked with training opportunities for post-harvest processing and maintaining quality of the products. Inventory methodologies for MAPs that have sizable harvests can also equip managers to make better harvest plans.

The research, especially on the domestication of targeted species, should continue with increased vigor. Motivated researchers should staff field research stations. The phyto-chemical screening of MAPs of various geographic origins can help identify better genetic resources for propagation and other bio-prospecting works.

Often, it seems, we need to educate ourselves first. The potentials of MAPs are enormous and many times more than the timber in a forest. The growth of many pharmaceutical and agro-business industries in developed countries is associated with the steady supply of new genetic materials from the wild. If we keep our policies right, create appropriate institutions and proactively look for opportunities, we can increase national incomes as well as the incomes of the rural communities by many folds. The critical part is making all people in the associated sectors aware, keeping them abreast of latest development in this field, and making them stakeholders in the growth of this sub-sector. If committed, doing these should be too difficult.

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